PMA209 Industry Day 2013

Future Airborne Capability Environment (FACE)

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PMA209 develops, integrates, and delivers avionics solutions that meet customer requirements, enable interoperability, and maximize affordability.

Agenda

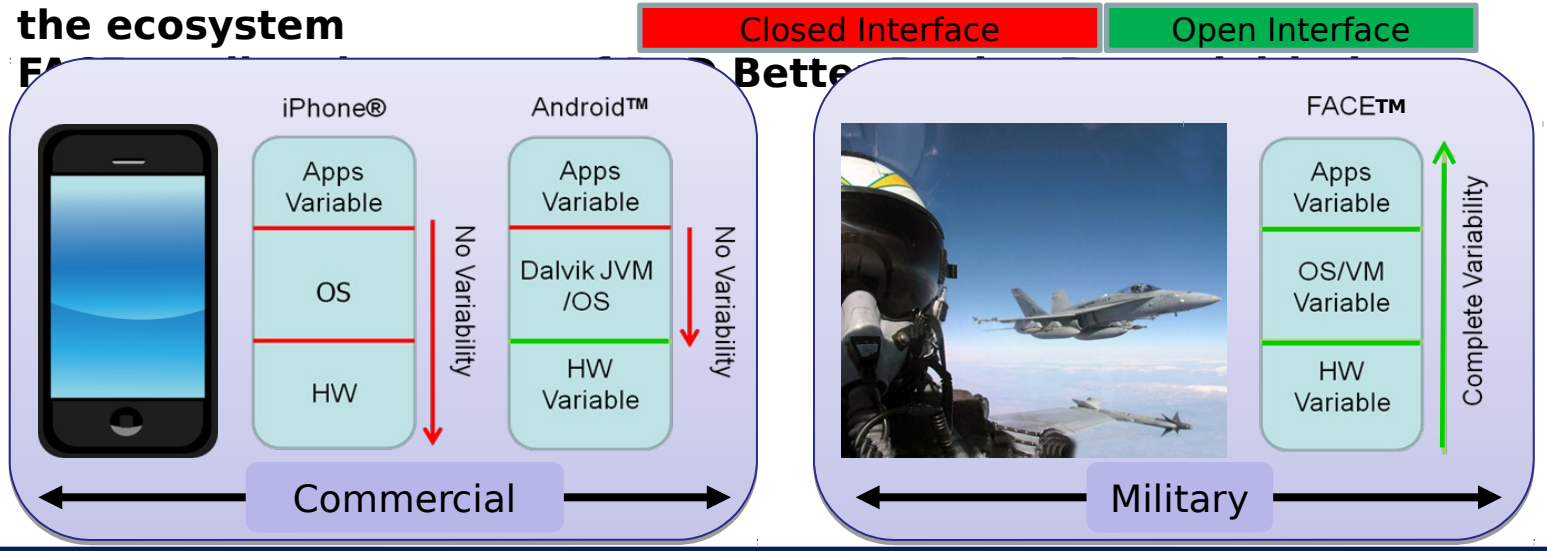
- **FACE Overview**
  - FACE Objectives
  - FACE Reference Architecture
  - AIR 00 Tasking
  - Schedule
  - Tasking Flow
  - Deliverables
  - Phase III Options
- **Summary**

FACE Objectives

- **Establish a COE to support portability of software across DoD airborne electronics platforms**
  - Determine a strict set of Open Standards for the environment
  - Builds upon tenants of Open Architecture (OA), Integrated Modular Avionics (IMA) and Modular Open Systems Approach (MOSA)
  - Portable, Modular, Partitioned, Scalable, Extendable, Secure
- **Reduce life cycle costs and time to field**
- **Obtain Industry and DoD Program Management endorsement**
- **Foster competitive avionics marketplace**
- **Facilitate adoption and conformance to maximize reuse and interoperability**

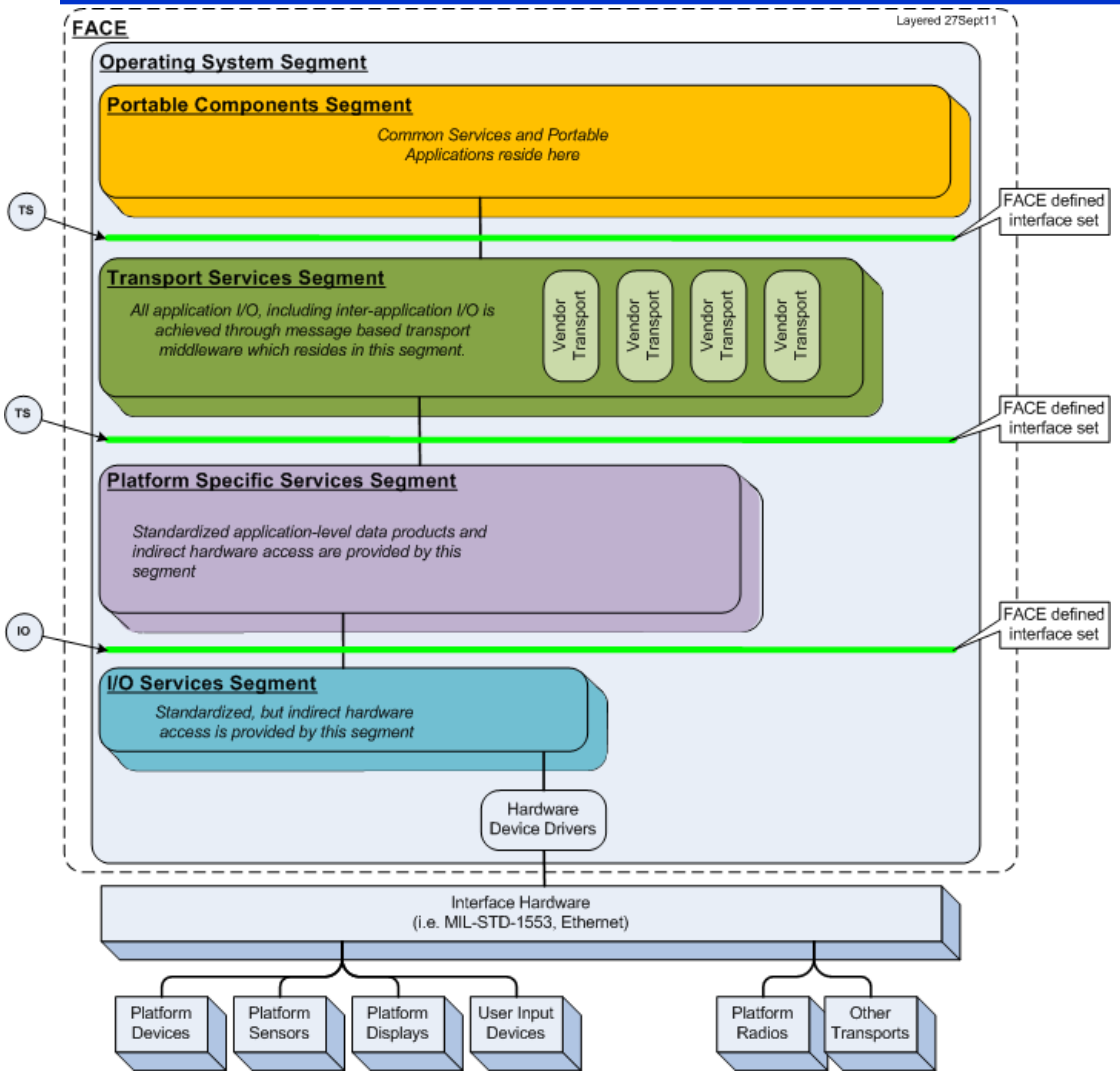
What is FACE?

- First and foremost, FACE is a standard of standards with a business strategy that is set to completely re-architect the acquisition of aircraft software systems
- FACE provides testable requirements to Modular Open System Architecture (MOSA) principles
- FACE aligns with and/or supports other Open Architecture (OA) initiatives
- FACE is addressing business and technical requirements in developing the ecosystem
- FA… Bette…



FACE is a bold new step in establishing greater Open System Architecture benefits in Defense Acquisition

FACE Reference Architecture

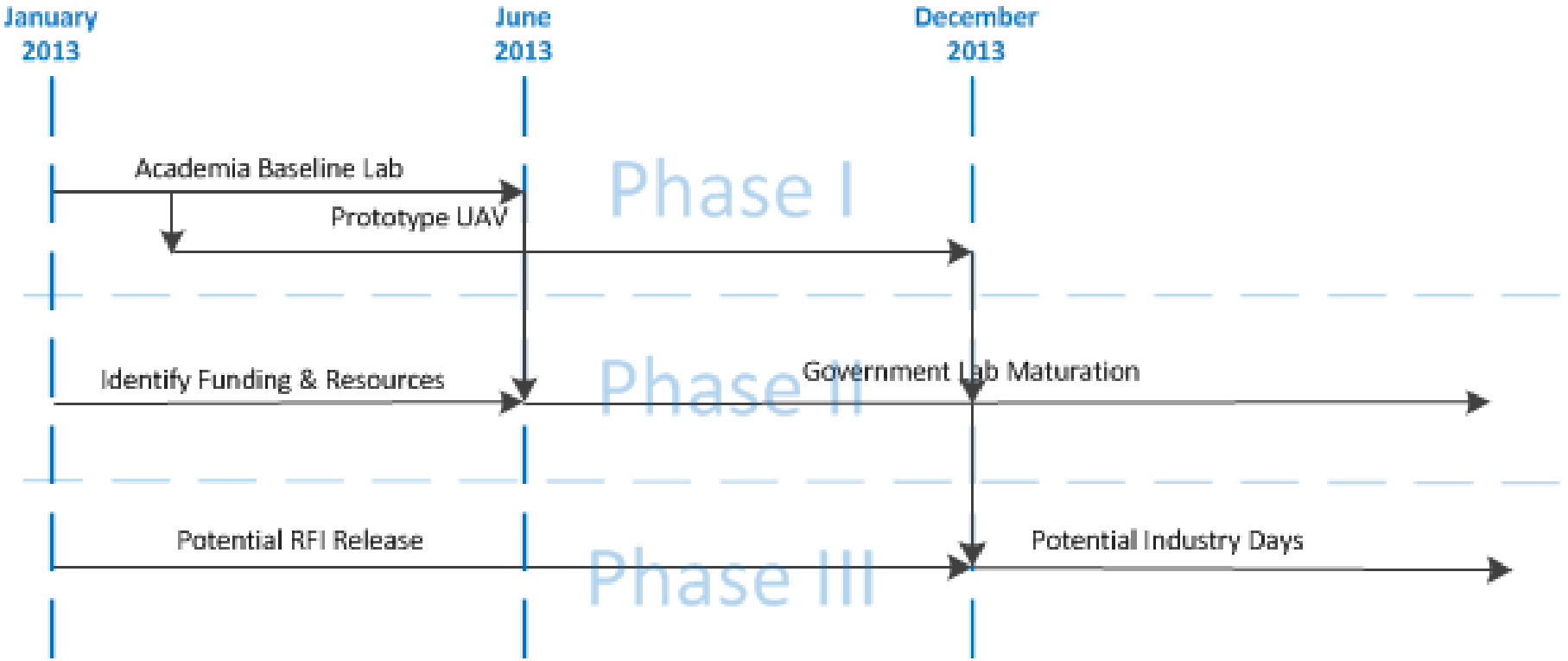


- **FACE Portable Components Segment**
  - Portable Applications
  - Portable Common Services
- **Transport Services Segment**
- **Platform Specific Services Segment**
  - Platform Device Services
  - Platform Common Services
  - Graphics Services
- **I/O Services Segment**
- **Drivers**
- **Operating System Segment**

AIR-00 Tasking

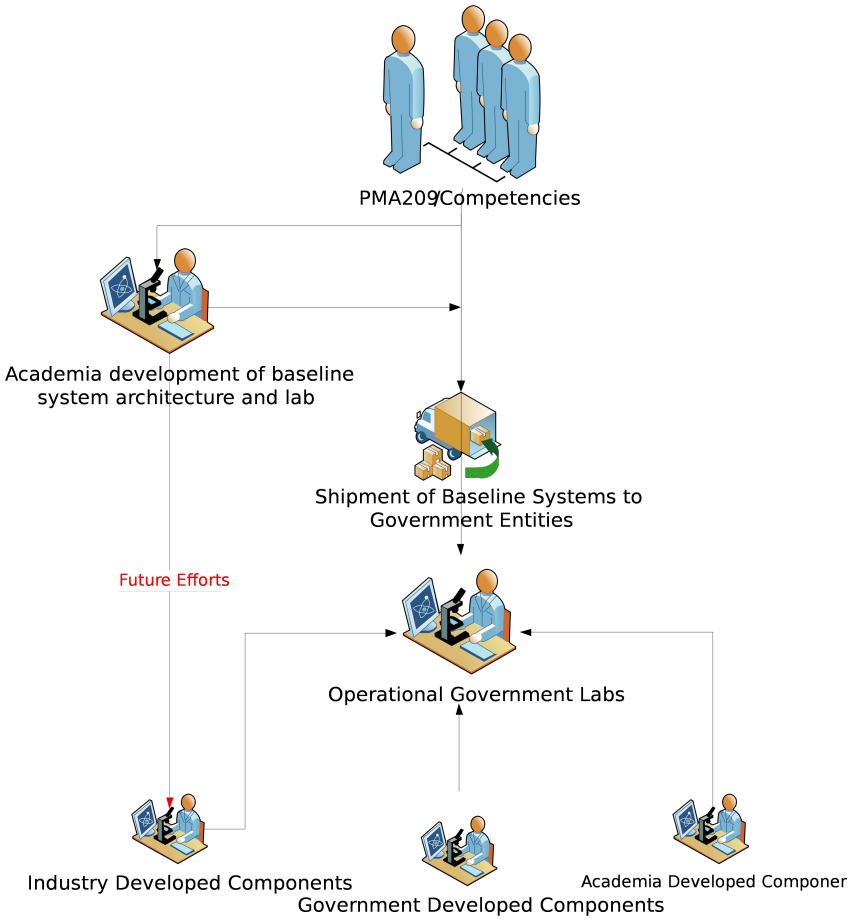
- **Build a FACE lab to develop the Technical Standard**
  - Fused A/A and A/S tracks in a FACE conformant architecture
  - Model open architecture to influence Next Gen Vertical Lift and FA-XX
  - Prove concept of standard by plugging existing radar, Electro-Infrared (EIR), and Embedded GPS/INS Inertial (EGI) into the lab
  - Ensure NAWCAD, NAWCWD and Industry participation
- **Identify organizational, training and financial changes needed to make the Business Model work**
- **Make this action part of the Integration and Interoperability (I&I) Commander's Guidance**

Proposed Schedule



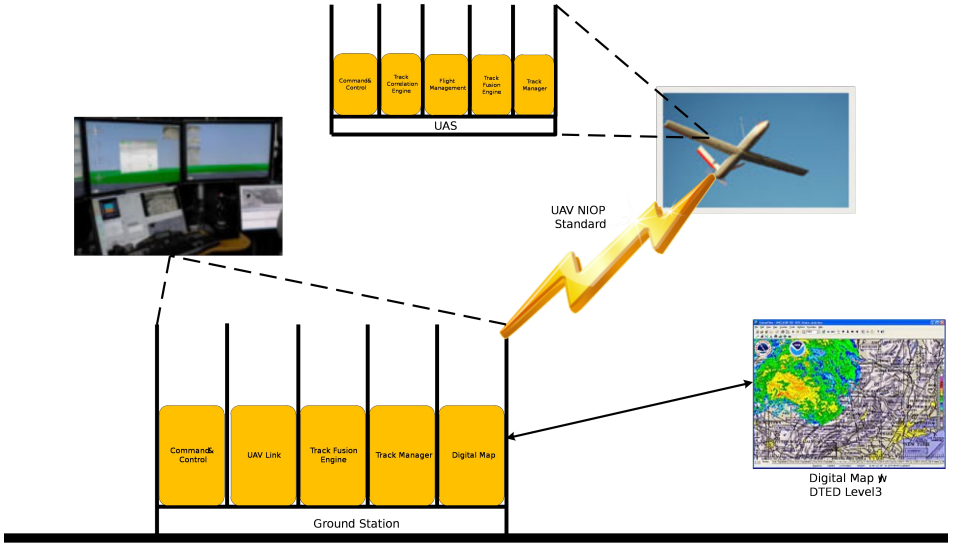
Tasking Flow

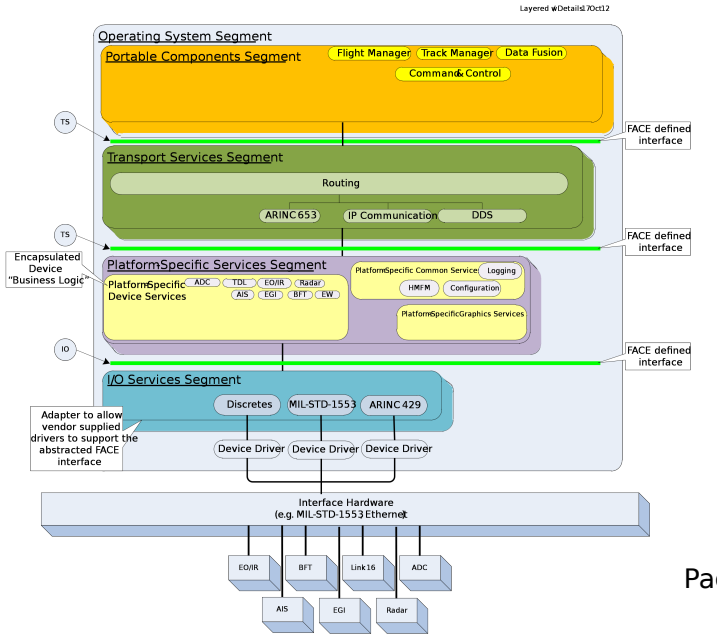
- **Phase I - PMA209 will establish a baseline architecture (based on ongoing FACE research)**
  - Georgia Tech Research Institute (GTRI)
  - Vanderbilt's Institute of Software Integrated Systems (ISIS)
  - Lab specifications
  - Initial track correlation/fusion capabilities
- **Phase II - Deliverables provided with GPR to gov't labs for future maturation**
  - Establish government lab for FACE maturation
  - Add or replace software capabilities and components
- **Phase III- Collaborative integration of new capabilities when gov't labs are operational**
  - Government, Academia and Industry
  - Track correlation/fusion application can be replaced with other fusion algorithms



Phase I/II FACE Demonstration

- **Purpose-Demonstrate FACE Architecture**
- **Implements FACE and UCS Conformant UAV and Ground Control Station**
  - Communication achieved through Navy Interoperability Profile (NIOP)
- **Provide host for track fusion capability**
  - Track Fusion demo application already developed and available at GTRI
- **Utilize surrogate UAV from GTRI**
  - Initial sensor suite will include Radar and EO/IR available at GTRI
  - Plan to migrate to I&I NIOP UAV test bed
- **Phase II**
  - Add or replace initial software capabilities and components





Phase III Options

- **Contract Options**
  - Investigating both Market Research and contract vehicle options to support Phase III
  - RFI released to get feedback from Industry
- **Benefits**
  - Promotes collaboration with industry
  - Allows industry to develop capabilities to plug into the FACE labs
  - Promotes innovation of new capabilities
  - Allows the Government to be the LSI and control the Architecture

Summary

- **FACE is a business strategy that can change the landscape of software acquisition**
- **FACE already aligns to NAVAIR Commander's Intent**
- **FACE has efforts underway that allow the proposal developed for AIR 00 to be executed immediately with low risk**
- **NAWCAD/WD and Industry involvement to help focus maturation of FACE labs to meet future platform requirements**

Backup Material

Proposed Schedule

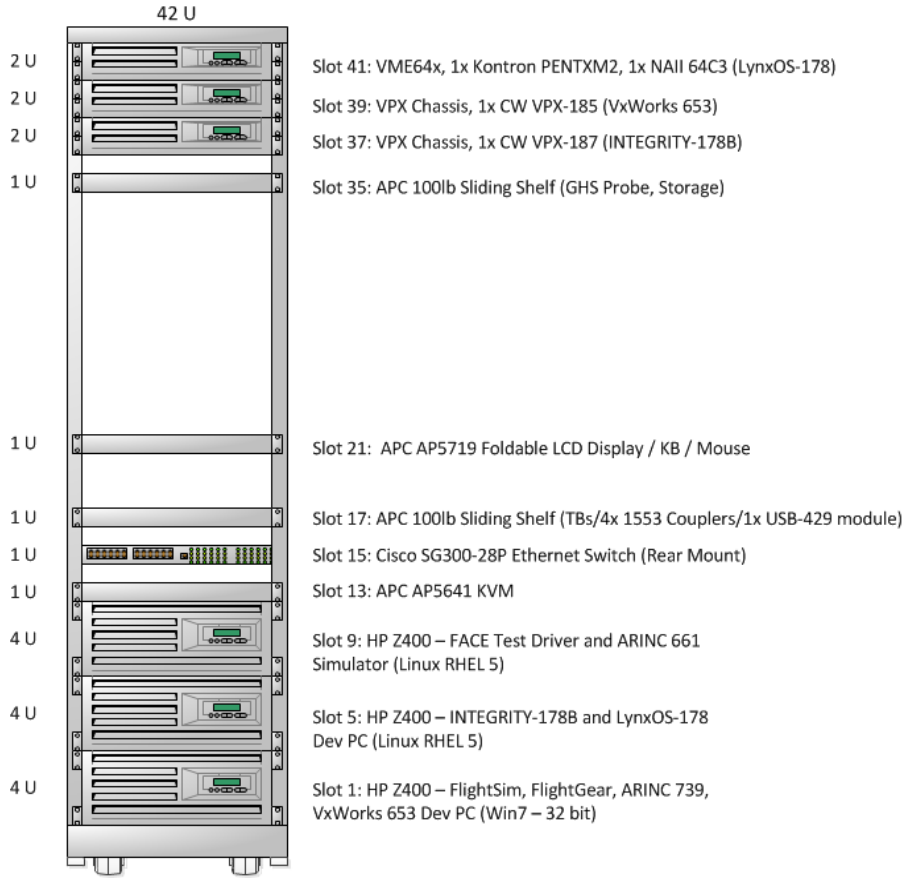
- **Phase I**
  - Establish baseline FACE architecture in a lab environment
  - Demonstrate broader FACE applicability utilizing reference applications (track fusion/correlation at a minimum)
  - Validate lab environment capabilities using a demonstration UAV with FACE conformant components interoperating with a FACE/UCS conformant ground station
  - Combines and leverages ongoing efforts funded by PMA209 and U.S. Army AMRDEC
  - Modifications to this phase will need to be assessed for impacts to cost and schedule
- **Phase II**
  - Plan, resource and execute Government lab maturation and additional lab or demonstration capabilities
  - Stakeholders will work to identify funding sources, organic subject matter expertise (SME) and determine roles and responsibilities in parallel with Phase I
  - Stakeholders will identify key insertion points and integration plans for maturing or extending the baseline lab and demonstration based on funds, schedule and SME availability
- **Phase III**
  - Government initiate and execute planning to support collaboration with industry, academia and government to mature and define future platform architectures

Phase I Deliverables

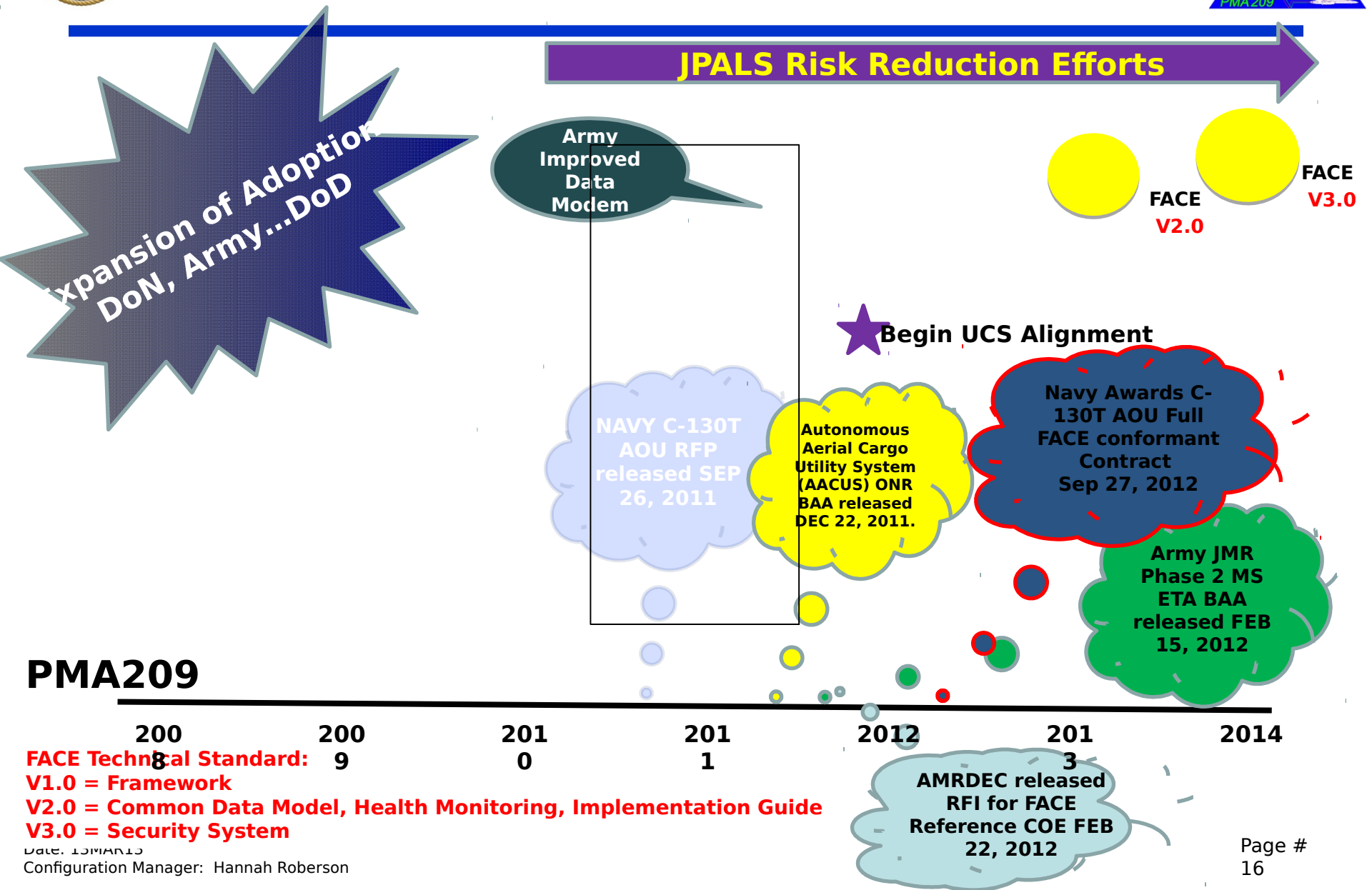
- **Baseline FACE Architecture Lab in government SIL for maturation efforts**
  - Hardware
  - Software
  - Specifications
  - Development Tools
- **FACE Data Model**
- **Design Documentation**
- **Source Code for integration components**
- **Source Code for Track Fusion Capability**
- **Source Code for Track Correlation Capability**

FACE Lab Environment

- **Establish FACE architecture at NAWC AD and WD labs**
  - Phase I leverages current FACE efforts
    - Rack includes multiple General Purpose Processors
    - Architecture based on the FACE Standard Edition 2.0
  - Phase II and III will be used to influence future software architecture and capability design, development and integration
    - FA-XX
    - FVL


42 U
2 U
Slot 41: VME64x, 1x Kontron PENTXM2, 1x NAII 64C3 (LynxOS-178)
2 U
Slot 39: VPX Chassis, 1x CW VPX-185 (VxWorks 653)
2 U
Slot 37: VPX Chassis, 1x CW VPX-187 (INTEGRITY-178B)
1 U
Slot 35: APC 100lb Sliding Shelf (GHS Probe, Storage)
1 U
Slot 21: APC AP5719 Foldable LCD Display / KB / Mouse
1 U
Slot 17: APC 100lb Sliding Shelf (TBs/4x 1553 Couplers/1x USB-429 module)
1 U
Slot 15: Cisco SG300-28P Ethernet Switch (Rear Mount)
1 U
Slot 13: APC AP5641 KVM
4 U
Slot 9: HP Z400 – FACE Test Driver and ARINC 661 Simulator (Linux RHEL 5)
4 U
Slot 5: HP Z400 – INTEGRITY-178B and LynxOS-178 Dev PC (Linux RHEL 5)
4 U
Slot 1: HP Z400 – FlightSim, FlightGear, ARINC 739, VxWorks 653 Dev PC (Win7 – 32 bit)

FACE Timeline


JPALS Risk Reduction Efforts
Expansion of Adoption DoN, Army…DoD
Army Improved Data Modem
FACE V2.0
FACE V3.0
Begin UCS Alignment
NAVY C-130T AOU RFP released SEP 26, 2011
Autonomous Aerial Cargo Utility System (AACUS) ONR BAA released DEC 22, 2011.
Navy Awards C-130T AOU Full FACE conformant Contract Sep 27, 2012
Army JMR Phase 2 MS ETA BAA released FEB 15, 2012
AMRDEC released RFI for FACE Reference COE FEB 22, 2012
PMA209
2008
2009
2010
2011
2012
2013
2014

FACE Technical Standard:
V1.0 = Framework
V2.0 = Common Data Model, Health Monitoring, Implementation Guide
V3.0 = Security System

FACE Consortium Members

Sponsors:
- Lockheed Martin
- Naval Air Systems Command (NAVAIR)
- US Army PEO Aviation
- Rockwell Collins

Principals:
- ATK
- BAE Systems
- Bell Helicopter
- Boeing
- Elbit Systems of America
- GE Aviation Systems
- General Dynamics
- Green Hills Software
- Harris Corp.
- Honeywell Aerospace
- Northrop Grumman
- Raytheon
- Sierra Nevada Corp.
- Sikorsky Aircraft
- Textron Systems

Associates:
- AdaCore
- Barco Federal Systems
- Brockwell Technologies
- CALCULEX
- Chesapeake Technology Int'l.
- CMC Electronics
- CTSi
- Curtiss-Wright Controls Defense Solutions
- DDC-I
- Defense Photonics
- Draper Laboratory
- Esterel Technologies
- FMS Secure Solutions
- GE Intelligent Platforms
- GoAhead Software
- Johns Hopkins Applied Physics Lab
- L-3 Communications

- LDRA Technology
- LynuxWorks
- Objective Interface Systems
- Physical Optics Corp.
- Presagis
- Real-Time Innovations
- Richland Technologies
- Stauder Technologies

The FACE Consortium was formed in 2010 by The Open Group

Better Buying Power 2.0 Alignment

- **Achieve Affordability & Control Life Cycle Costs**
- **Incentivize Productivity and Innovation in Industry and Government**
  - Development of capability vice platform unique infrastructure
- **Promotes Effective Competiti**
  - Provides a consistent competitive environment to vendors regardless of size
  - Open Systems Architecture and set rules for acquisition of technical data rights
- **FACE Reduces Barriers for Small Businesses to Compete for Aircraft Platform Software**
- **Reduces Software Development Tim**
  - Modularization and portability

Breaks Vendor Lock

Measures of Effectiveness TBD

FACE will change the business model and competitive landscape for DoD aviation software acquisition

Open Architecture Requirement

- **DoD Directive 5000.1**
  - "E1.1.27. Systems Engineering. Acquisition programs shall be managed through the application of a systems engineering approach that optimizes total system performance and minimizes total ownership costs. A modular, open-systems approach shall be employed, where feasible."
- **N6/N7 Naval Open Architecture (NOA) Requirements Letter 9010, Ser N6N7/5U916276, 23 Dec 05**
  - This letter establishes the requirement to implement Open Architecture (OA) principles across the Navy Enterprise. Warfare systems include hardware, software and people.
- **SECNAVINST 5000.2E**
  - "Naval open architecture precepts shall be applied across the Naval Enterprise as an integrated technical and business approach and shall be used for all systems, including support systems, when developing an Acquisition Strategy per ASN(RD&A) memorandum of 5 Aug 04 and CNO (N6/N7) memorandum of 23 Dec 05 with enclosure (1)."
- **FACE is a rigorous and enforceable definition of OA**
  - FACE is a standard, not a program or product
  - Single, open interpretation of existing industry standards and software best practices
  - Established collaboratively between services and industry
  - Initiated to achieve the goals of OA by explicitly addressing the business and technical issues which plagued other OA attempts

FACE Versions

- **FACE v1.0**
  - Baseline Technical Standard and Business Guide
  - Proof of concepts prove or disprove viability/functionality of proposed reference architecture
  - Initial software, integrator and conformance toolkits and reference applications
- **FACE v2.0**
  - Includes all updates from FACE v1.X series plus new functionality
  - Adds Data Model
  - Update toolkits and reference applications to verify all interfaces included in FACE v2.0
- **FACE v3.0**
  - Updates from FACE v2.X series
  - Adds new functionality
    - Improved support for native FACE application development
    - Update Hypervisor/Separation Kernel/MILS Interfaces including classified support

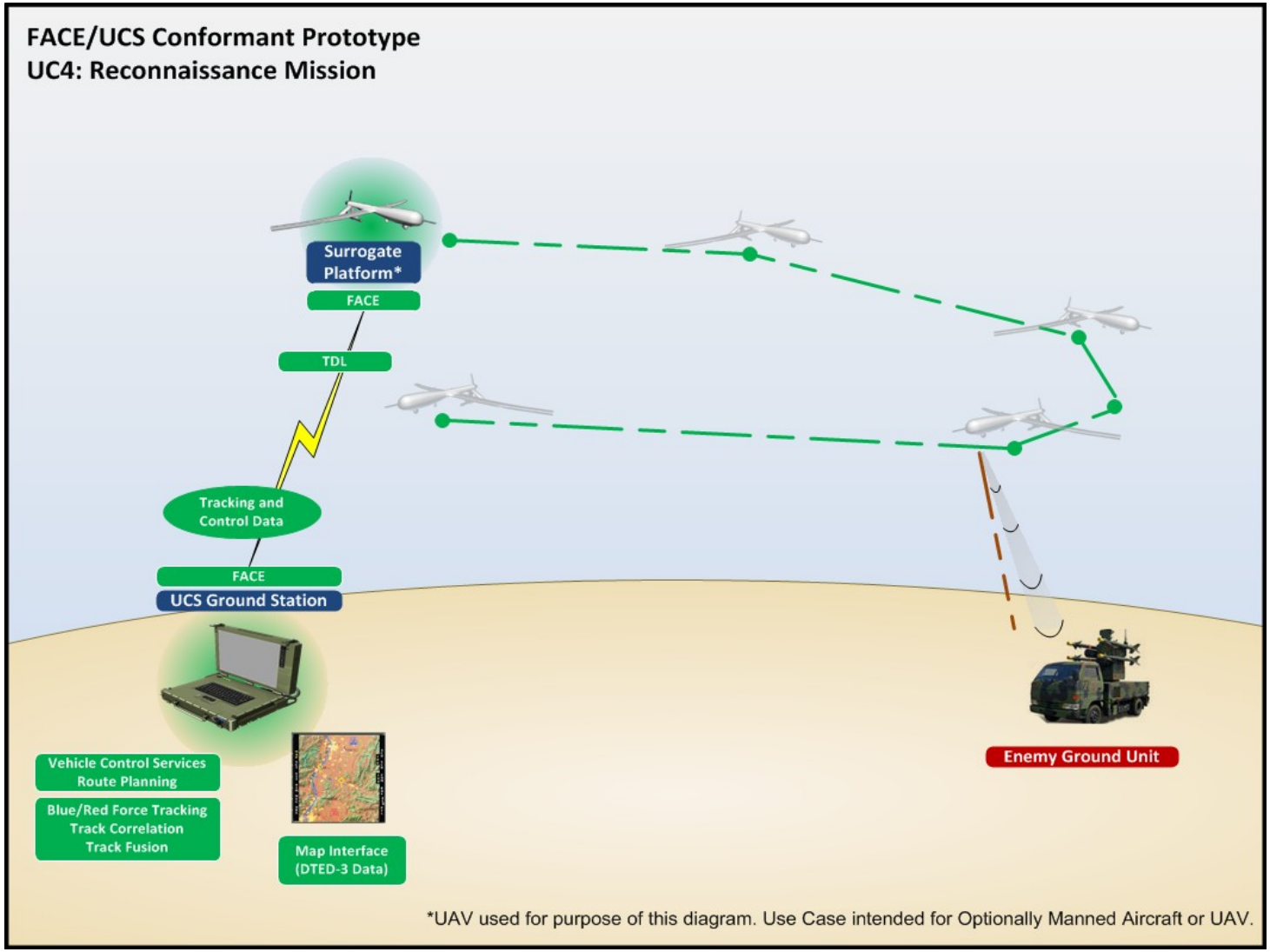
Use Case Overview

- **Presented in increasing order of complexity**
- **UC3 (subsystem Use Case) supports UC1 and UC2**
- **UC4 serves as the initial capability**
- **UC2 adds additional complexity added to UC4**
- **UC1 builds on UC2 to present an Operational Viewpoint (OV)-1 view**
  - Represents the highest level of mission/system complexity to be achieved
  - Aid in requirements definition
  - Not intended to imply that the OV-1 case is a specific target for completion in CY13

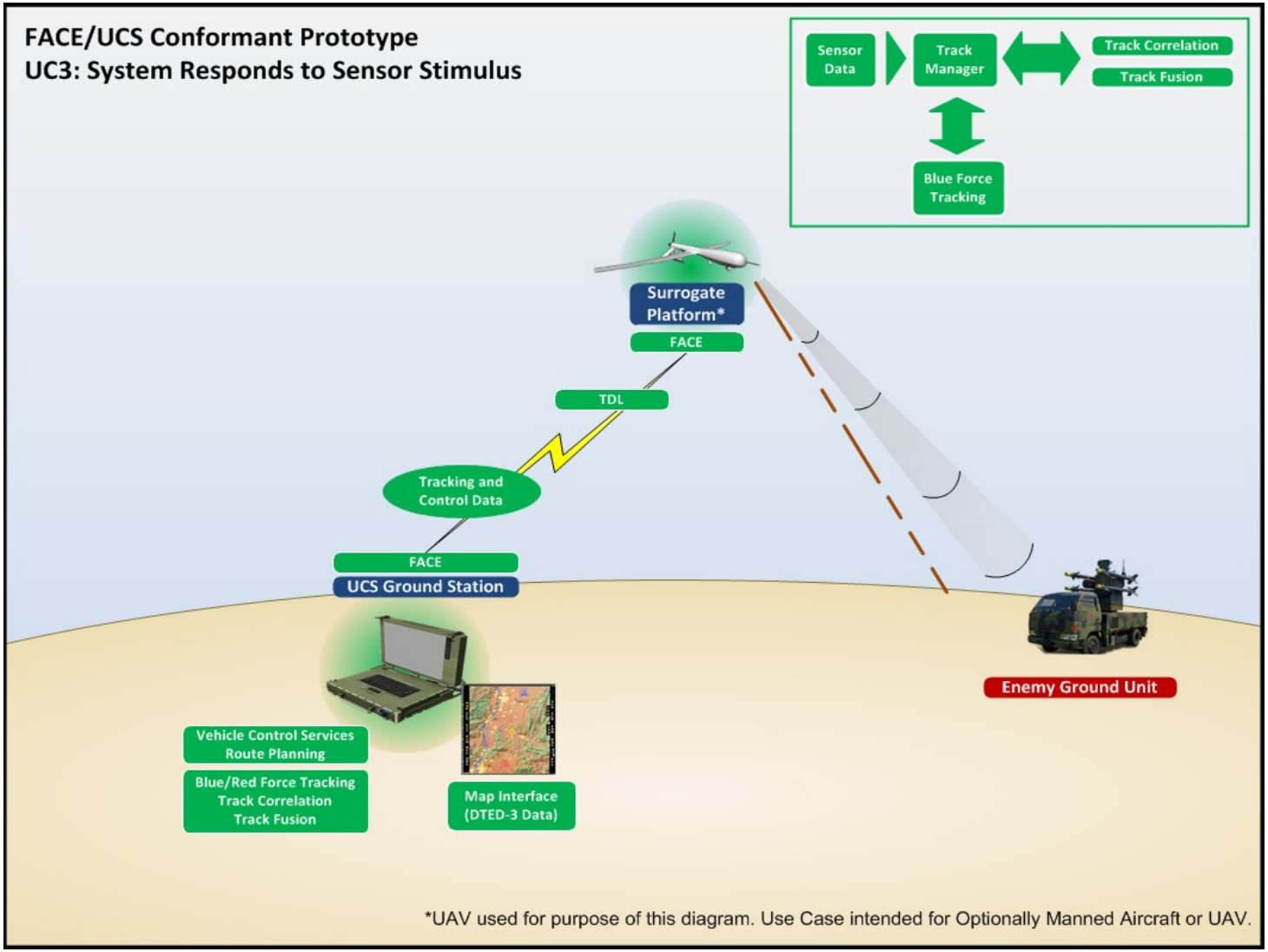
Diagram Assumptions

- **Air vehicle considered the primary airborne actor in the Use Case and the Unmanned Aircraft System (UAS) Control Segment (UCS) Ground Station (UCSGS) have been highlighted in green**
- **Other friendly forces shown are not primary actors for the Use Case but provide and consume data (e.g. via Blue Force Tracking) as part of the entire mission objectives**
- **Real hardware will be used to the max extent where feasible**
- **Simulations may be required to supplement the scenario**

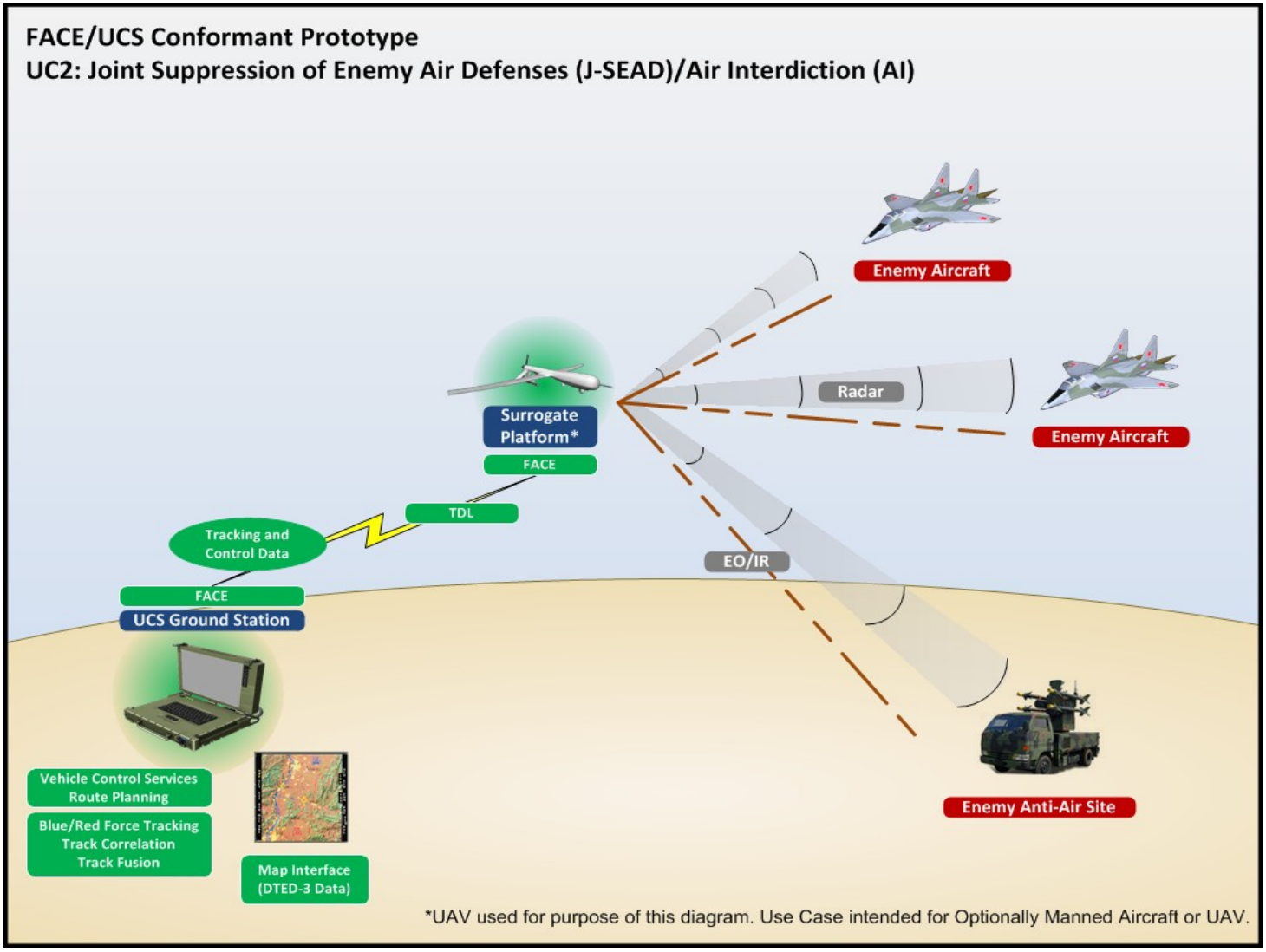
Use Case # 4


FACE/UCS Conformant Prototype
UC4: Reconnaissance Mission
Surrogate Platform*
FACE
TDL
Tracking and Control Data
FACE
UCS Ground Station
Vehicle Control Services
Route Planning
Blue/Red Force Tracking
Track Correlation
Track Fusion
Map Interface (DTED-3 Data)
Enemy Ground Unit
*UAV used for purpose of this diagram. Use Case intended for Optionally Manned Aircraft or UAV.

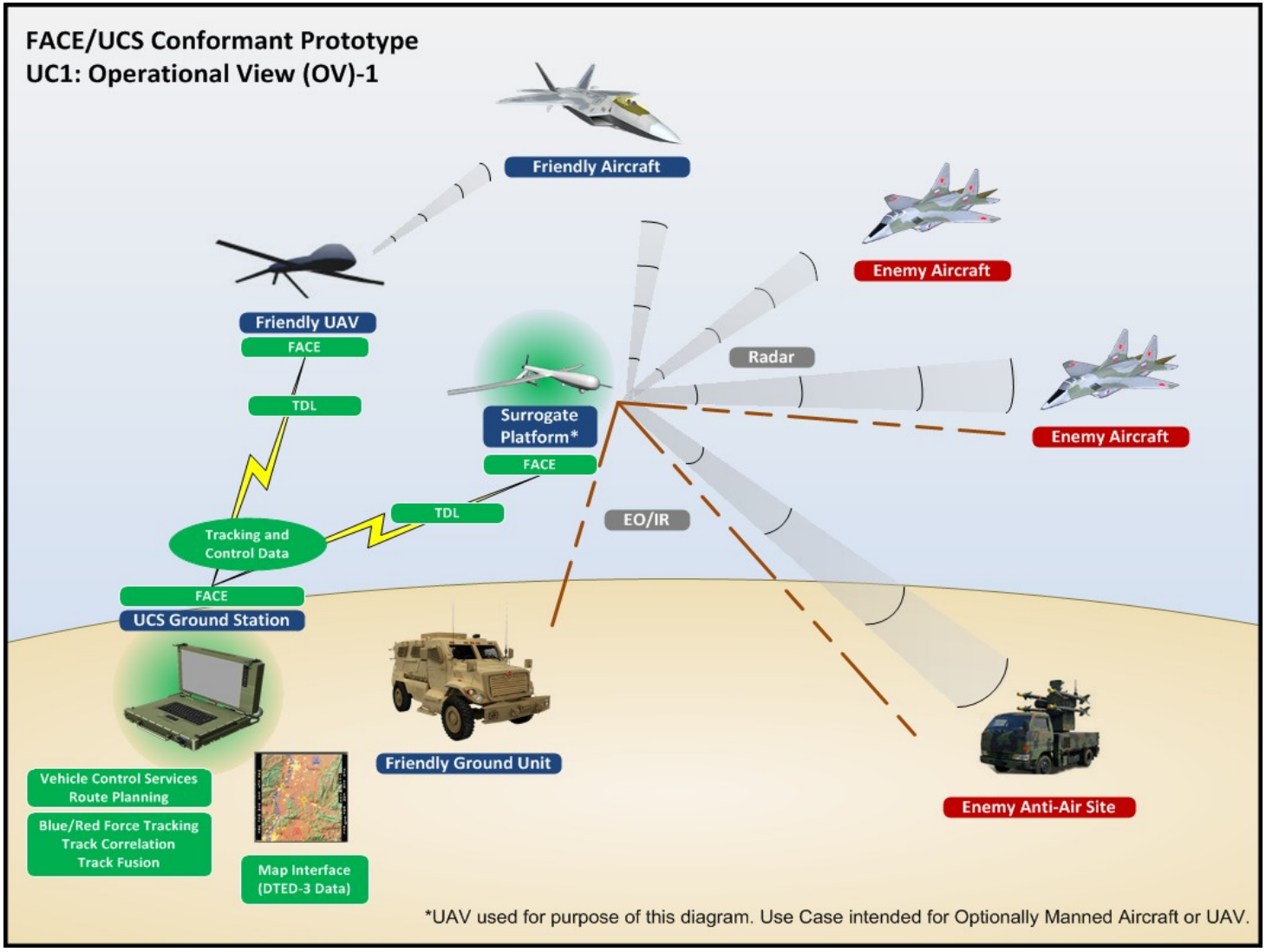
Use Case # 3


FACE/UCS Conformant Prototype
UC3: System Responds to Sensor Stimulus
Sensor Data
Track Manager
Track Correlation
Track Fusion
Blue Force Tracking
Surrogate Platform*
FACE
TDL
Tracking and Control Data
FACE
UCS Ground Station
Vehicle Control Services
Route Planning
Blue/Red Force Tracking
Track Correlation
Track Fusion
Map Interface (DTED-3 Data)
Enemy Ground Unit
*UAV used for purpose of this diagram. Use Case intended for Optionally Manned Aircraft or UAV.

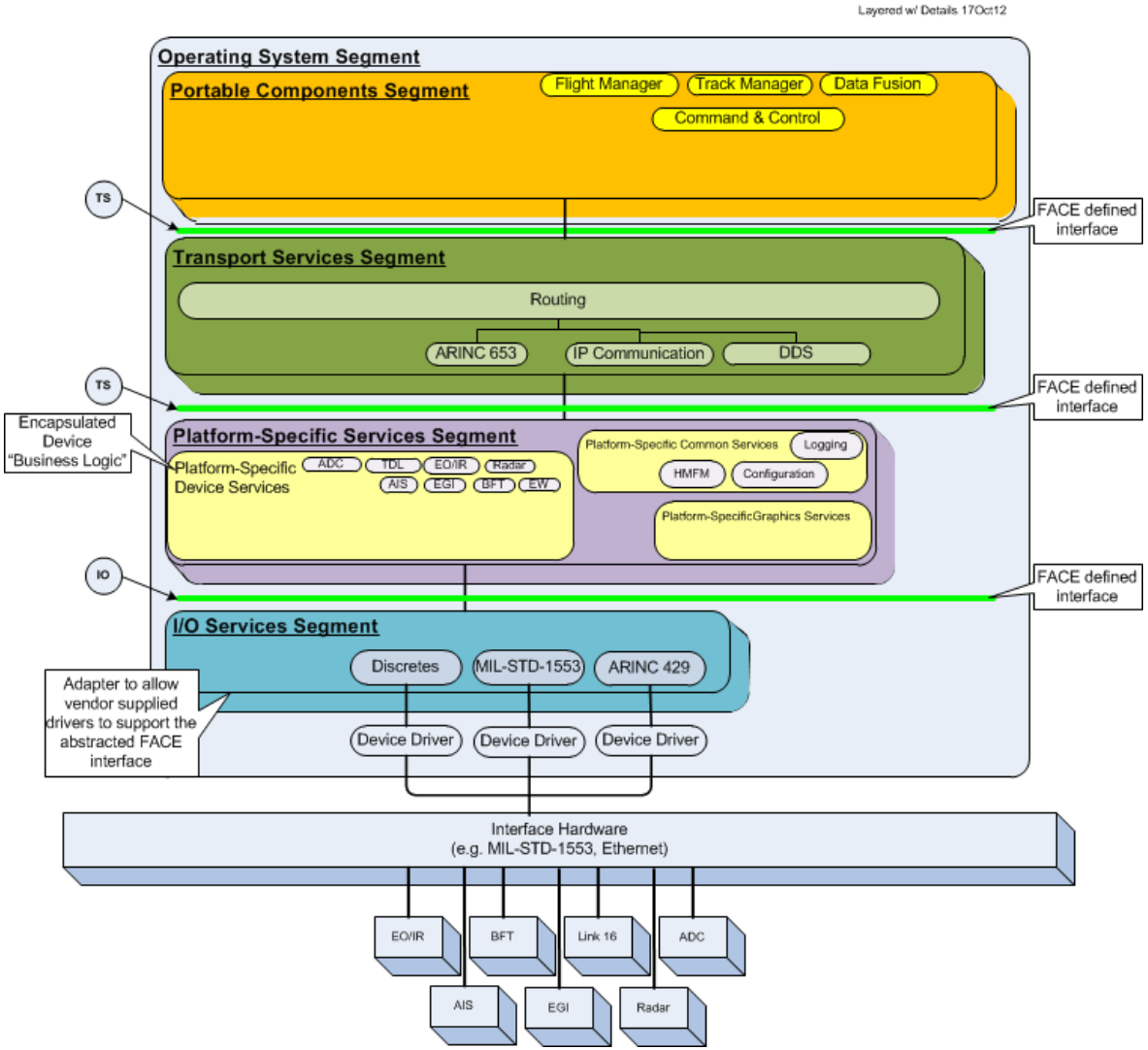
Use Case # 2


FACE/UCS Conformant Prototype
UC2: Joint Suppression of Enemy Air Defenses (J-SEAD)/Air Interdiction (AI)
Enemy Aircraft
Radar
Enemy Aircraft
Surrogate Platform*
FACE
TDL
Tracking and Control Data
FACE
UCS Ground Station
EO/IR
Vehicle Control Services
Route Planning
Blue/Red Force Tracking
Track Correlation
Track Fusion
Map Interface (DTED-3 Data)
Enemy Anti-Air Site
*UAV used for purpose of this diagram. Use Case intended for Optionally Manned Aircraft or UAV.

Use Case # 1


FACE/UCS Conformant Prototype
UC1: Operational View (OV)-1
Friendly Aircraft
Enemy Aircraft
Friendly UAV
FACE
TDL
Radar
Surrogate Platform*
FACE
Enemy Aircraft
TDL
EO/IR
Tracking and Control Data
FACE
UCS Ground Station
Friendly Ground Unit
Enemy Anti-Air Site
Vehicle Control Services
Route Planning
Blue/Red Force Tracking
Track Correlation
Track Fusion
Map Interface
(DTED-3 Data)
*UAV used for purpose of this diagram. Use Case intended for Optionally Manned Aircraft or UAV.

Notional FACE AV Architecture



Notional FACE GS Architecture